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Dated: October 12, 2010 Signature: /Randol W. READ/ Reg. #43876
Randol W. Read

PATENT
Atty. Dkt. No. WEAT/0555

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: Kersey et al.	§	Filed: January 13, 2004
Serial No.: 10/756,183	§	Group Art Unit: 2883
Confirmation No.: 2079	§	Examiner: J.M. Blevins

For: SENSING DEVICE HAVING A LARGE DIAMETER D-SHAPED OPTICAL WAVEGUIDE

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

APPEAL BRIEF

Applicants submit this Appeal Brief to the Board of Patent Appeals and Interferences on appeal from the decision of the Examiner of Group Art Unit 2883 dated June 11, 2010, finally rejecting claims 1, 3, 6, 8-9, and 11. The final rejection of claims 1, 3, 6, 8-9, and 11 is appealed. This Appeal Brief is believed to be timely since it is transmitted by the due date of October 12, 2010, as set by the filing of a Notice of Appeal on August 12, 2010.

Enclosed for filing is the required fee of $540.00 associated with this brief, herewith paid for via credit card. The Commissioner is hereby authorized to charge underpayments or credit overpayments to counsel's Deposit Account No. 20-0782/WEAT/0555/RWR.

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Real Party in Interest

The present application has been assigned to Weatherford/Lamb, Inc., Houston, TX.

Related Appeals and Interferences

Applicants assert that no other appeals or interferences are known to the Applicants, the Applicants' legal representative, or assignee, which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

Status of Claims

Claims 1, 3, 6, 8-9, and 11 are pending in the application. Claims 1-20 were originally presented in the application. Claims 2, 4-5, 7, 10, and 12-20 were canceled without prejudice. Claims 1, 3, 6, 8-9, and 11 stand finally rejected as discussed below. The final rejections of claims 1, 3, 6, 8-9, and 11 are appealed. The pending claims are shown in the attached Claims Appendix.

Status of Amendments

All claim amendments have been entered by the Examiner. No amendments to the claims were proposed after the final rejection.

Summary of Claimed Subject Matter

Claimed embodiments of the invention provide optical sensors formed from an optical waveguide with a large outer transverse diameter and a substantially D-shaped portion (see, *e.g.*, paragraph [0002] lines 1-3 of the present application).

A. CLAIM 1 – INDEPENDENT

Claim 1 is directed to an optical sensor for sensing a measurand (see, *e.g.*, optical sensor 300 in FIGs. 3-4). The optical sensor generally includes an optical waveguide having an outer cladding (see, *e.g.*, cladding 14 in FIGs. 3-4) and at least one inner core (see, *e.g.*, core 12 in FIGs. 3-4) disposed therein which propagates light (see, *e.g.*, paragraph [0014] lines 1-3); a D-shaped portion of the optical waveguide having a generally D-shaped cross-section (see, *e.g.*, D-shaped portion 10 in FIGs. 3-4 and paragraph [0015] lines 1-2), wherein a property of the D-shaped portion changes in response to the measurand, the property being polarization or birefringence (see, *e.g.*, paragraph [0017]); and a layer disposed on a flat surface of the D-shaped portion (see, *e.g.*, coating 302 in FIGs. 3-4 and paragraph [0018] lines 1-8), wherein a refractive index of the layer changes in response to a change in the measurand (see, *e.g.*, paragraph [0018] lines 9-21).

B. CLAIM 8 – INDEPENDENT

Claim 8 is directed to an optical sensor for sensing a measurand (see, *e.g.*, optical sensors 500, 600 in FIGs. 5-6). The optical sensor generally includes a first D-shaped waveguide having a generally D-shaped cross-section (see, *e.g.*, first D-shaped optical waveguide 510, 610 in FIGs. 5-6, paragraph [0022] lines 1-5, and paragraph [0023] lines 1-4); a second D-shaped waveguide having a generally D-shaped cross-section (see, *e.g.*, second D-shaped optical waveguide 511, 611 in FIGs. 5-6, paragraph [0022] lines 1-5, and paragraph [0023] lines 1-4), wherein the first and second D-shaped waveguides are optically coupled together (see, *e.g.*, paragraph [0022] lines 5-17) and wherein a property of at least one of the first and second D-shaped waveguides changes in response to the measurand, the property being

polarization or birefringence (see, *e.g.*, paragraph [0017]); and a layer disposed between the first and second D-shaped waveguides (see, *e.g.*, coating 501, 601 in FIGs. 5-6, paragraph [0022] lines 5-7, and paragraph [0023] lines 5-8), the layer capable of changing thickness in response to the measurand, wherein the measurand includes at least one member of the group consisting of heat, humidity, light, electric field, magnetic field and chemicals (see, *e.g.*, paragraph [0018] lines 9-21, paragraph [0022] lines 7-16, and paragraph [0023] lines 5-8).

Grounds of Rejection to be Reviewed on Appeal

1. Rejection of claims 1, 3, 6, and 8 under 35 U.S.C. 103(a) as being unpatentable over *Chan et al.* (U.S. Patent No. 6,194,120, hereinafter, "*Chan*") in view of *Jorgenson et al.* (U.S. Patent No. 5,647,030, hereinafter, "*Jorgenson*") and in view of *Ronnekleiv et al.* (U.S. Publication 2002/0041724, hereinafter, "*Ronnekleiv*").

2. Rejection of claim 9 under 35 U.S.C. 103(a) as being unpatentable over *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* as applied to claim 8 above and further in view of *Bergh* (U.S. Patent No. 4,386,822).

3. Rejection of claim 11 under 35 U.S.C. 103(a) as being unpatentable over *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* as applied to claim 8 above and further in view of *Bailey et al.* (U.S. Publication 2002/0197037, hereinafter, "*Bailey*").

ARGUMENTS

1. Rejection of claims 1, 3, 6, and 8 under 35 U.S.C. 103(a) as being unpatentable over *Chan* in view of *Jorgenson* and in view of *Ronnekleiv.*

The Applicable Law

The Examiner bears the initial burden of establishing a prima facie case of obviousness. See MPEP § 2141. Establishing a prima facie case of obviousness begins with first resolving the factual inquiries of *Graham v. John Deere Co.*, 383 U.S. 1 (1966). The factual inquiries are as follows:

(A) determining the scope and content of the prior art;
(B) ascertaining the differences between the claimed invention and the prior art;
(C) resolving the level of ordinary skill in the art; and
(D) considering any objective indicia of nonobviousness.

Once the *Graham* factual inquiries are resolved, the Examiner must determine whether the claimed invention would have been obvious to one of ordinary skill in the art.

The References

Chan is "directed to the formulation of novel photochromic polymeric materials containing alternative organic chromophores. Such materials exhibit negligible second-order polarizability prior to exposure to actinic radiation and excellent nonlinear optical properties after exposure and polarization" (col. 4 lines 6-14). *Chan* is also directed to "[o]ptical waveguides prepared by irradiating selected regions of positive photochromic polymeric materials with actinic radiation. The photochromic materials undergo an irreversible photochemical change which results in an increase in the refractive index of light-exposed regions" (Abstract). *Chan* discloses alternate methods of optical waveguide preparation where "the waveguide region is created by exposing the core to actinic radiation and elevating the refractive index of the exposed region" (col. 8 lines 14-22).

Jorgenson "is directed to a[n] optical fiber sensor which detects a sample in contact with the sensor by surface plasmon resonance (SPR) measurements," as well as methods and apparatus relating thereto (col. 4 lines 45-47 and Abstract). "The fiber optic SPR sensor includes a surface plasmon supporting metal layer in contact with an exposed portion of the optical fiber core, and may optionally contain one or more additional layers deposited on the surface plasmon supporting metal layer" (Abstract). *Jorgenson* is also directed to measuring the resonance spectrum to determine "the complex refractive index of the sample in contact with the sensing area of the optical fiber sensor" (col. 7 lines 60-62). "For example, by measuring the resonance spectrum of a solution containing sugar, the concentration of the sugar can be determined (assuming the sugar is the only varying analyte in the solution that caused the real refractive index of the sample to change)" (col. 8 lines 3-7).

Ronnekleiv is directed to a:

> body compatible fiber optic sensor probe for invasive medical use...The probe includes at least one sensing location at which the fiber is configured to provide at least one detectable changeable optical property responsive to strain within the fiber, and at least one sensing element which undergoes a volumetric change in response to an in body parameter to be sensed. The sensing element is coupled to the fiber in such a way that the volumetric change induces strain within the fiber so as to vary the detectable optical property or properties.

(Abstract).

The Examiner's Argument

Regarding claim 1, the Examiner argues that:

> *Chan* teaches an optical sensor for sensing a measurand (Figures 1b and 2, abstract and column 8, lines 15-34, the measurand being electric field), comprising: an optical waveguide (30) having an outer cladding (50) and at least one inner core (40) disposed therein which propagates light (column 25, lines 39-57); and a D-shaped portion of the optical waveguide having a generally D-shaped cross-section (Figures 1b and 2); and a layer (60) disposed on a flat surface of the D-shaped portion, wherein a refractive index of the layer changes (column 25, line 65 – column 26, line 43)

(page 3 of the Examiner's Office Action mailed June 11, 2010, hereinafter, "Examiner's Final Action").

Although the Examiner concedes *Chan* does not specifically teach the refractive index of the layer changing in response to the measurand, the Examiner asserts that:

> *Jorgenson* teaches an optical sensor for sensing a measurand wherein the refractive index of a layer changes in response to the measurand (column 7, line 60 – column 8, line 45). It would have been obvious to one of ordinary skill in the art at the time of the invention to have the changing of the refractive index of the layer of *Chan* be in response to the measurand, as taught by *Jorgenson*. The motivation would have been to improve the capabilities of measuring the measurand.

Id., at pages 3-4.

Although the Examiner concedes that *Chan* also does not teach that a polarization or a birefringence of the optical waveguide changes in response to the measurand, the Examiner asserts that:

> *Ronnekleiv* teaches birefringence of an optical waveguide changing in response to a measurand (paragraph 115). It would have been obvious to one of ordinary skill in the art at the time of the invention to change a polarization or a birefringence of the optical waveguide of *Chan* in response to a measurand, as taught by *Ronnekleiv*. The motivation would have been to improve the sensing capabilities of the optical waveguide.

Id., at page 4.

Regarding claim 8, the Examiner makes a similar argument that:

> *Chan* teaches an optical sensor for sensing a measurand (Figures 1b and 2, abstract and column 8, lines 15-34, the measurand being electric field), comprising: a first D-shaped waveguide having a generally D-shaped cross-section (30); a second D-shaped waveguide having a generally D-shaped cross-section (280), wherein the first and second D-shaped waveguides are optically coupled together (column 27, lines 1-26); and a layer (260) disposed between the first and second D-shaped waveguides (Figure 2), the layer capable of changing thickness (column 25, line 65 – column 26, line 43), wherein the measurand includes at least one of the members of the group consisting of heat, humidity, light, electric field, magnetic field and chemicals (column 8, lines 15-34).

Id.

Although the Examiner concedes that *Chan* does not specifically teach the refractive index of the layer changing thickness in response to the measurand, the Examiner asserts that:

> *Jorgenson* teaches an optical sensor for sensing a measurand wherein the thickness of a layer changes in response to the measurand (column 7, line 60 – column 8, line 45). It would have been obvious to one of ordinary skill in the art at the time of the invention to have the changing of the thickness of the layer of *Chan* be in response to the measurand, as taught by *Jorgenson*. The motivation would have been to improve the capabilities of measuring the measurand.

Id., at pages 4-5.

Although the Examiner concedes that *Chan* also does not teach that a polarization or a birefringence of the optical waveguide changes in response to the measurand, the Examiner asserts that:

> *Ronnekleiv* teaches birefringence of an optical waveguide changing in response to a measurand (paragraph 115). It would have been obvious to one of ordinary skill in the art at the time of the invention to change a polarization or a birefringence of the optical waveguide of *Chan* in response to a measurand, as taught by *Ronnekleiv*. The motivation would have been to improve the sensing capabilities of the optical waveguide.

Id., at page 5.

In the Examiner's Response to Arguments section of the Examiner's Final Action, the Examiner argues that:

> *Chan*…is relied upon for its teaching of an optical sensor comprising a D shaped optical waveguide (Figures 1b and 2 and column 8, lines 15-34), whereas…*Ronnekleiv*…is relied upon for its teaching of an optical sensor wherein polarization or birefringence of an optical waveguide changes in response to a measurand. Examiner maintains that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the D shaped optical waveguide of *Chan* such that its polarization or birefringence changes in response to the measurand, as taught by *Ronnekleiv*….*Ronnekleiv* does not need to specifically teach a D shaped waveguide, as this limitation is already articulated in the *Chan* reference,

> and the *Ronnekleiv* reference is relied upon as motivation for modifying any optical waveguide of an optical sensor, including the D shaped one of *Chan*.

Id., at pages 2-3.

Applicants' Response to the Examiner's Argument

Applicants respectfully submit that the present rejection fails to satisfy at least the first (A) and second (B) *Graham* factual inquiries. In particular, Applicants submit that because the Examiner has not properly characterized the teachings of the references and/or the claims at issue, the Examiner has failed to recognize important differences between the claimed invention and the references. Thus, a prima facie case of obviousness has not been established.

For example, the Examiner relies on *Ronnekleiv* as teaching "birefringence of an optical waveguide changing in response to a measurand" (page 4 of the Examiner's Final Action). However, *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* does not teach, show, or suggest "a property of the *D-shaped portion* changes in response to the measurand, the property being polarization or birefringence" as recited in independent claim 1 (emphasis added). The Examiner concedes that *Chan* "does not teach that a polarization or a birefringence of the optical waveguide changes in response to the measurand," the optical waveguide being D-shaped or otherwise. *Id.* *Jorgenson* is silent with respect to polarization or birefringence and, therefore, fails to overcome the deficiencies in *Chan*.

Despite the Examiner's contentions, *Ronnekleiv* is also silent with respect to a property of a *D-shaped* portion changing in response to a measurand as required in independent claim 1 and, therefore, fails to overcome the deficiencies in *Chan* in view of *Jorgenson*. Applicants respectfully submit that the Examiner overlooks a limitation and, thus, ignores the scope of independent claim 1 wherein a property of the *D-shaped portion* changes in response to the measurand. The Board's attention is directed to the present application where, for example, the D-shaped portion 10 of a sensor 200 has a flat surface 100 and a rounded outer surface (paragraph [0015] lines 1-2 and FIG. 1). "In response to the axial strain 201 or the cross axis strain 202, the [D-shaped] sensor

200 creates or changes the polarization or the birefringence of the light 15 passing through the sensor 200 to provide an optical signal indicative of the strain on the sensor 200" in this example (paragraph [0017] lines 1-6 and FIG. 2).

In the Response to Arguments section of the Examiner's Final Action, the Examiner argues that "*Ronnekleiv* does not need to specifically teach a D shaped waveguide, as this limitation is already articulated in the *Chan* reference, and the *Ronnekleiv* reference is relied upon as motivation for modifying any optical waveguide of an optical sensor, including the D shaped one of *Chan* (pages 2-3 of the Examiner's Final Action). However, Applicants respectfully submit not only that *Ronnekleiv* fails to overcome the deficiencies of *Chan* in view of *Jorgensen* as discussed above, but that the combination of *Chan* and *Ronnekleiv* is improper.

Chan and *Ronnekleiv* are from different technical fields and, therefore, are non-analogous art, such that a person having ordinary skill in the art would not look to combine *Chan* and *Ronnekleiv*. Applicable case law requires that "the reference must either be in the field of the applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned." *In re Oetiker*, 977 F.2d 1443, 1447 (1992). *Chan* relates to "optical integrated circuits" for "on-chip, chip-to-chip, and board-to-board interconnections" (Abstract; col. 1 lines 19-22). On the other hand, *Ronnekleiv* relates to a "body compatible fiber optic sensor probe for invasive medical use" (Abstract). Probes for invasive medical use are far removed from and have vastly different concerns and design constraints than interconnecting optoelectronics. Therefore, Applicants respectfully submit that a person having ordinary skill in the art would not consider combining *Chan* and *Ronnekleiv*, and thus, the Examiner's combination of *Chan* and *Ronnekleiv* is improper.

Thus, Applicants submit that the Examiner has created a combination of elements from non-analogous art, in a manner that reconstructs the Applicants' invention only with the benefit of hindsight, which is insufficient to establish a *prima facie* case of obviousness, according to *In re Oetiker*.

Therefore, for at least the reasons presented above, *Ronnekleiv* fails to overcome the deficiencies in *Chan* in view of *Jorgenson*. Claim 8 recites similar limitations to claim 1 not taught by the art of record.

Accordingly, Applicants submit that claims 1 and 8, as well as claims dependent therefrom, are allowable and respectfully request withdrawal of this rejection.

2. Rejection of claim 9 under 35 U.S.C. 103(a) as being unpatentable over *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* as applied to claim 8 above and further in view of *Bergh*.

The Applicable Law

The Examiner bears the initial burden of establishing a prima facie case of obviousness. See MPEP § 2141. Establishing a prima facie case of obviousness begins with first resolving the factual inquiries of *Graham v. John Deere Co.*, 383 U.S. 1 (1966). The factual inquiries are as follows:

(A) determining the scope and content of the prior art;
(B) ascertaining the differences between the claimed invention and the prior art;
(C) resolving the level of ordinary skill in the art; and
(D) considering any objective indicia of nonobviousness.

Once the *Graham* factual inquiries are resolved, the Examiner must determine whether the claimed invention would have been obvious to one of ordinary skill in the art.

The References

Chan, *Jorgenson*, and *Ronnekleiv* have already been described above.

Bergh is directed to apparatus and methods for changing the degree of polarization of light in a waveguide, such as an optical fiber (Abstract and col. 1 lines 15-18). This is achieved by removing a portion of the cladding of a strand of fiber optic material and mounting a body of birefringent material in the area in which the material has been removed, in close proximity to the core of the fiber (Abstract). "The birefringent material modifies the propagation of two polarization modes within the fiber in such [a] manner that one of the modes is coupled to a bulk wave mode and removed from the guide, while the second mode excites no bulk waves and remains guided." *Id.*

The Examiner's Argument

Regarding claim 9, the Examiner argues that *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* as applied to claim 8 and further in view of *Bergh* teaches "an optical sensor comprising a D-shaped optical waveguide (Figure 2) wherein the waveguide propagates light in substantially a few spatial modes . . . It would have been obvious to one of ordinary skill in the art at the time of the invention to propagate light through the waveguide of *Chan* in substantially a few spatial modes, as taught by *Bergh*. The motivation would have been to increase the bandwidth of the propagating light" (pages 5-6 of the Examiner's Final Action).

Applicants' Response to the Examiner's Argument

Applicants believe that *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* as applied to claims 1, 3, 6, and 8 has been overcome. Specifically, Applicants believe that *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* does not teach each element of the base claim for the reasons given above. Therefore, a prima facie case of obviousness has not been established. *Bergh* fails to overcome the deficiencies in *Chan* in view of *Jorgenson* and in view of *Ronnekleiv*. Although *Bergh* teaches that the addition of birefringent material modifies the propagation of two polarization modes during fabrication of the waveguide (Abstract), *Bergh* does not teach, show, or suggest polarization or birefringence of a D-shaped (portion of a) waveguide changing in response to a measurand as required by independent claims 1 and 8.

Accordingly, Applicants submit that claim 9 is patentable over *Chan* in view of *Jorgenson* and *Ronnekleiv*, and in further view of *Bergh*. Withdrawal of the rejection is respectfully requested.

3. Rejection of claim 11 under 35 U.S.C. 103(a) as being unpatentable over *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* as applied to claim 8 above and further in view of *Bailey*.

The Applicable Law

The Examiner bears the initial burden of establishing a prima facie case of obviousness. See MPEP § 2141. Establishing a prima facie case of obviousness begins with first resolving the factual inquiries of *Graham v. John Deere Co.*, 383 U.S. 1 (1966). The factual inquiries are as follows:

(A) determining the scope and content of the prior art;
(B) ascertaining the differences between the claimed invention and the prior art;
(C) resolving the level of ordinary skill in the art; and
(D) considering any objective indicia of nonobviousness.

Once the *Graham* factual inquiries are resolved, the Examiner must determine whether the claimed invention would have been obvious to one of ordinary skill in the art.

The References

Chan, *Jorgenson*, and *Ronnekleiv* have already been described above.

Bailey is directed to an optical waveguide that permits access to the evanescent field, wherein a "portion of the optical waveguide has a generally D-shaped cross-section and a transverse outer waveguide dimension that is greater than about 0.3 mm" (paragraphs [0004] and [0005]). The D-shaped portion "provides a flat surface for access to the evanescent field for optical coupling into or out of the waveguide, and/or for attachment or alignment purposes" (paragraph [0006] lines 7-9).

The Examiner's Argument

Regarding claim 11, the Examiner argues that *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* as applied to claim 8 and further in view of *Bailey* teaches "an optical sensor and sensing method comprising first and second D-shaped optical waveguides wherein the first and second D-shaped waveguides include a plurality of cores (Figures 20-22). It would have been obvious to one of ordinary skill in the art at the time of the invention to include the multiple cores of *Bailey* in the waveguide of *Chan*. The motivation would have been to increase the number of waveguiding paths" (page 6 of Examiner's Final Action).

Applicants' Response to the Examiner's Argument

Applicants believe that *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* as applied to claims 1, 3, 6, and 8 has been overcome. Specifically, Applicants believe that *Chan* in view of *Jorgenson* and in view of *Ronnekleiv* does not teach each element of the base claim for the reasons given above. Therefore, a prima facie case of obviousness has not been established. *Bailey* does not overcome the deficiencies in *Chan* in view of *Jorgenson* and in view of *Ronnekleiv*.

Accordingly, Applicants submit that claim 11 is patentable over *Chan* in view of *Jorgenson* and *Ronnekleiv*, and in further view of *Bailey*. Withdrawal of the rejection is respectfully requested.

CONCLUSION

The Examiner errs in finding that:

1. Claims 1, 3, 6, and 8 are unpatentable over *Chan* in view of *Jorgenson* and *Ronnekleiv*;

2. Claim 9 is unpatentable over *Chan* in view of *Jorgenson* and *Ronnekleiv*, and further in view of *Bergh*; and

3. Claim 11 is unpatentable over *Chan* in view of *Jorgenson* and *Ronnekleiv*, and further in view of *Bailey*.

Withdrawal of the rejections and allowance of all claims are respectfully requested.

Respectfully submitted, and
S-signed pursuant to 37 CFR 1.4,

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CLAIMS APPENDIX

1. (Previously Presented) An optical sensor for sensing a measurand, comprising:

an optical waveguide having an outer cladding and at least one inner core disposed therein which propagates light;

a D-shaped portion of the optical waveguide having a generally D-shaped cross-section, wherein a property of the D-shaped portion changes in response to the measurand, the property being polarization or birefringence; and

a layer disposed on a flat surface of the D-shaped portion, wherein a refractive index of the layer changes in response to a change in the measurand.

2. (Canceled)

3. (Previously Presented) The optical sensor of claim 1, wherein the measurand includes at least one of the members of the group consisting of heat, humidity, light, electric field, magnetic field and chemicals.

4-5. (Canceled)

6. (Original) The optical sensor of claim 1, wherein a transverse outer dimension of the waveguide is greater than 0.3 millimeters.

7. (Canceled)

8. (Previously Presented) An optical sensor for sensing a measurand, comprising:

a first D-shaped waveguide having a generally D-shaped cross-section;

a second D-shaped waveguide having a generally D-shaped cross-section, wherein the first and second D-shaped waveguides are optically coupled together and wherein a property of at least one of the first and second D-shaped waveguides changes in response to the measurand, the property being polarization or birefringence; and

a layer disposed between the first and second D-shaped waveguides, the layer capable of changing thickness in response to the measurand, wherein the measurand includes at least one member of the group consisting of heat, humidity, light, electric field, magnetic field and chemicals.

9. (Original) The optical sensor of claim 8, wherein the first D-shaped waveguide has at least one first inner core disposed therein which propagates light in substantially a few spatial modes and the second D-shaped waveguide has at least one second inner core disposed therein which propagates light in substantially a few spatial modes.

10. (Canceled)

11. (Original) The optical sensor of claim 8, wherein the first and second D-shaped waveguides include a plurality of cores.

12-20. (Canceled)

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.